Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound

January 1996

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PREFACE

The Puget Sound Estuary Program (PSEP) is a multiagency group formed to promote the protection and beneficial use of Puget Sound and its resources. The members of PSEP seek an integrated and consistent approach to managing the actions and events that influence the Sound. This PSEP document is an example of how PSEP has employed a multiagency approach to improve the quality and consistency of environmental information collected in Puget Sound.

In the past, collection and analysis of Puget Sound environmental samples in different studies typically were performed in various unstandardized ways. Some of these differences reflected improvements in sample collection and analysis techniques over the years, while others resulted from differences in preferences, knowledge, or objectives of the investigators. Quite often, these differences among protocols have severely limited the overall usefulness of the information collected.

The protocols recommended in this document have been developed to encourage scientific investigators to use, whenever possible, well-defined and consistent methods for sampling and analyzing environmental data from Puget Sound. All of the protocols have been reviewed and evaluated by regional scientists from government agencies, consulting firms, and academic institutions. The protocols are provided in a loose-leaf notebook format so that they may be updated easily, and new protocols may be added in the future. The protocols may serve as brief, detailed refreshers to those who have performed these kinds of sampling and analyses before. They can also serve as guidelines to those who are writing proposals or issuing contracts for collection and analysis of the kinds on information included in this manual. The information gathered as part of most Puget Sound environmental surveys, general monitoring programs, and intensive investigations will be of higher quality, and more useful to others, if these recommended protocols are followed whenever possible.

The recommendation to use these protocols should not be viewed as an attempt to force all scientific investigators to use the same protocols for every kind of study. The selection of appropriate protocols for a given study depends on the specific objectives of each individual investigation. However, the protocols described in this manual should be viewed as fully acceptable to achieve information of high quality (i.e., investigators should conduct sampling analyses, and quality assurance/quality control programs at this level or better).

The protocols recommended in this document will be updated periodically. Questions or comments regarding this document should be addressed to:

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Finally, the contributions made by the many scientists who donated their time and expertise to making these protocols as accurate and useful as possible are gratefully acknowledged.

Introduction

For

U.S. Environmental Protection Agency
Region 10, Office of Puget Sound
Seattle, Washington

U.S. Army Corps of Engineers
Seattle District
Seattle, Washington

March 1990

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PURPOSE

Environmental variables in Puget Sound are measured by a wide variety of organizations, including government agencies, universities, and private institutions. However, comparisons of results of different studies frequently are limited because different methods are used to measure the same variables. The ability to compare data among different studies is highly desirable for developing a comprehensive management strategy for the Sound.

This document (i.e., notebook) presents recommended protocols for measuring selected environmental variables in Puget Sound. The objective is to encourage most investigators conducting studies such as monitoring programs, baseline surveys, and intensive investigations to use equivalent methods whenever possible. If this objective is achieved, most data from future sampling programs should be comparable among studies. It is recognized that alternative methods exist for many of the variables considered in this document and that those methods may produce data of equal or better quality than do the recommended methods. However, the criterion that data should be comparable limited the range of methods recommended in this document. It is also recognized that future research or other circumstances may require modification or replacement of one or more of the recommended methods. The loose-leaf format of this document was selected specifically to allow such changes to be made.

The recommendations in this document pertain primarily to the methodological specifications required to measure the selected environmental variables. Recommendations for study design and data analysis generally were not included because those considerations vary widely depending upon the objectives of individual studies. As mentioned previously, the goal of this document is to ensure that comparable data are generated by different studies. This does not necessarily require that all studies have the same initial design, nor that all data are analyzed in the same manner after being generated. It is recommended, however, that sample collection and analysis specifications of study designs be similar enough to ensure that comparable data are produced whenever possible.

As an action separate from the preparation of this document, several of the recommended protocols will be required for use in governmental regulatory permit programs. For example, the Puget Sound Dredged Disposal Analysis (PSDDA) intends to specify several of the recommended protocols as requirements when conducting dredged material regulatory testing and disposal site assessments. Use of such standardized procedures is essential for making comparisons to regulatory standards and reference conditions.

SCOPE

A meeting was convened by the U.S. Environmental Protection Agency on 31 May 1985 to determine the priority of variables for protocol development or documentation. Variables were ranked on the basis of three major criteria:

1. The frequency with which each variable has been measured in a variety of studies (e.g., monitoring programs, baseline surveys, intensive investigations) throughout Puget Sound

2. The importance of each variable for making decisions related to environmental problems in the Sound

3. The degree to which a variety of methods has been used to measure each variable.

Using the criteria listed above, 12 groups of variables were identified as having the highest priority for protocol development or documentation. They include:

- Station positioning considerations
- Conventional sediment variables
- Concentrations of organic compounds in sediment and tissue
- Concentrations of metals in sediment and tissue
- Benthic infaunal variables
- Sediment bioassays
- Pathological conditions in fish livers
- Microbiological indicators
- Characteristics of soft-bottom demersal fish assemblages
- Concentrations of chemicals in marine mammal tissue
- Conventional marine water variables
- Conventional fresh water variables.

Recommended protocols for all of these variables are presented in later sections of this document. In addition to these 12 groups of variables, a number of others were considered appropriate for protocol development. The loose-leaf format of this document will allow additional protocols to be included in the future.

In addition to the recommended protocols for each group of variables, a section on general quality assurance/quality control (QA/QC) procedures is included in this document. That section identifies the major QA/QC concerns that should be addressed when collecting and analyzing environmental samples from Puget Sound.

APPROACH

The recommended protocols for each group of variables were developed by convening a workshop comprised of representatives from most organizations that routinely measure or use the variables of concern in Puget Sound. The objective of each workshop was to evaluate various methods and, if possible, agree upon which methods should be used in the future. Consideration was given to providing data that will be comparable with the historical database. Prior to each workshop, the methods used historically in Puget Sound were evaluated and specific items requiring standardization were identified. Additional considerations for developing the various recommended protocols included data quality needs, cost, availability of equipment, and expertise.

Each workshop focused on defining acceptable methods and determining which of those methods would provide comparable data. If several acceptable methods did not provide comparable data, the workshop participants were asked to select only one for future use. As expected, a full consensus rarely was achieved. However, in many cases the majority of participants clearly favored a single method. In other instances, the participants were relatively evenly divided between recommending two or more methods.

After each workshop, draft protocols were developed. As much as possible, recommendations of each protocol were based on the majority viewpoint of the workshop participants. In some cases, a single recommendation could not be given for a particular specification because no agreement was reached at the workshop. In such instances, various specifications used by different Puget Sound investigators were simply described.

Draft protocols were mailed to all workshop participants and other interested parties for written review. Following this review, comments made by several reviewers were incorporated into the protocols. Most major comments made by single reviewers were resolved with each respective reviewer. After all written reviews were addressed, protocols were finalized and included as a chapter of this document.

FORMAT

Each protocol in this document is designed to stand alone. However in many studies related variables are measured simultaneously. In such cases, the protocol for one variable may require some modification to be consistent with that of a second variable. For example, collection of sediment subsamples for analysis of conventional variables (e.g., particle size, total volatile solids, total organic carbon) normally does not require collection equipment to be washed with special solvents. However, if sediment subsamples also will be collected from the same sample for analysis of organic compounds, collection equipment for the conventional subsample must be washed with the same solvent specified for collection of the organics subsample to avoid contaminating the latter sediment. For studies considering multiple variables, it is therefore recommended that the protocols for all relevant variables be reviewed carefully before sampling begins to ensure that all appropriate modifications are made.

The formats for most protocols are similar to facilitate use of the entire document. The following major sections are presented for most protocols:

- **Use and Limitations**—Describes what a variable measures and major limitations to the use of the variable

- **Field Procedures**—Describes container type, special cleaning procedures, collection techniques, sample quantity, preservation technique, storage conditions, and maximum holding time

- **Laboratory Procedures**—Describes analytical procedures (or provides citations), laboratory equipment, sources of error, and QA/QC specifications

- **Data Reporting Requirements**—Describes the kinds of data that the analytical laboratory should report and the units in which the data should be reported.

CAVEATS

Several notes of caution require emphasis before the protocols in this document are presented. First, these protocols were developed solely to promote the collection of comparable data in Puget Sound. A variety of other methods may exist that produce data of equal or better quality than the recommended protocols. However, the criterion that data should be comparable limited the range of methods recommended in this document.

A second caveat is that rarely was a full consensus reached with respect to any aspect of any protocol. Therefore, it should not be construed that all individuals, agencies, and institutions that participated in this effort agreed with all of the final products. The recommended protocols are simply a best effort to represent the majority viewpoints of the many individuals from diverse backgrounds that attended the workshops or commented on the draft protocols.

A third caveat is that this document is intended to be dynamic. The loose-leaf format was selected specifically for this reason. Modifications or additions to the protocols can therefore be made in the future if needs or viewpoints change, or if methodological refinements or improvements are made.